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## RANDOM FIELD ERRORS IN THE TEVATRON DIPOLES

A. V. Tollestrup

This poorly educated student of natural philosophy would like to report on some unworthy calculations concerning the field errors in the Tevatron dipoles. The subject addressed here is how do the fluctuations in some of the lower order multipoles vary as one changes position across the gap. In order to investigate this, I've taken a set of 39 of our dipoles and calculated  $b_1(x)$  and  $b_2(x)$  at 500 amps. I have then averaged this over the magnets set, and Figs. 1 and 2 display the average value and its rms fluctuation. The current used is 500 amps, which is near injection time. The slope in the average value of  $b_1$  for this magnet set is due to the large negative sextupole term present in the magnets. It is to be noted that in  $b_1$  the rms fluctuation grows almost linearly with distance away from the origin. On the other hand, the fluctuations in  $b_2$  are more or less constant out to  $\pm 1/2$  in. at which point a rapid deterioration sets in. Fig. 3 shows the effect of setting the multipole coefficients  $b_1$  through  $b_4$  equal to zero and calculating  $b_1(x)$  and  $b_2(x)$  from the higher multipoles. It is seen from this figure that the higher multipoles have very little influence inside of the region  $\pm 1/2$  in. and rapidly dominate the behavior of the gradient and the sextupole moment outside of this region.

In my humble opinion, I would like to be permitted to suggest that perhaps a conclusion can be drawn from this data. To wit: The magnets behave

in a reasonably controlled way out to  $\pm 1/2$  in. and deteriorate so fast past this point that it does not seem likely that this is a region of the magnet where beam could be stored or accelerated. And if indeed one were permitted to express an opinion, I would venture to say that Fig. 1 and 2 show a rather controlled behavior of the coefficients over this internal  $\pm 1/2$  in. interval. In any case, of course, the reader may draw his own conclusions if they differ from these.

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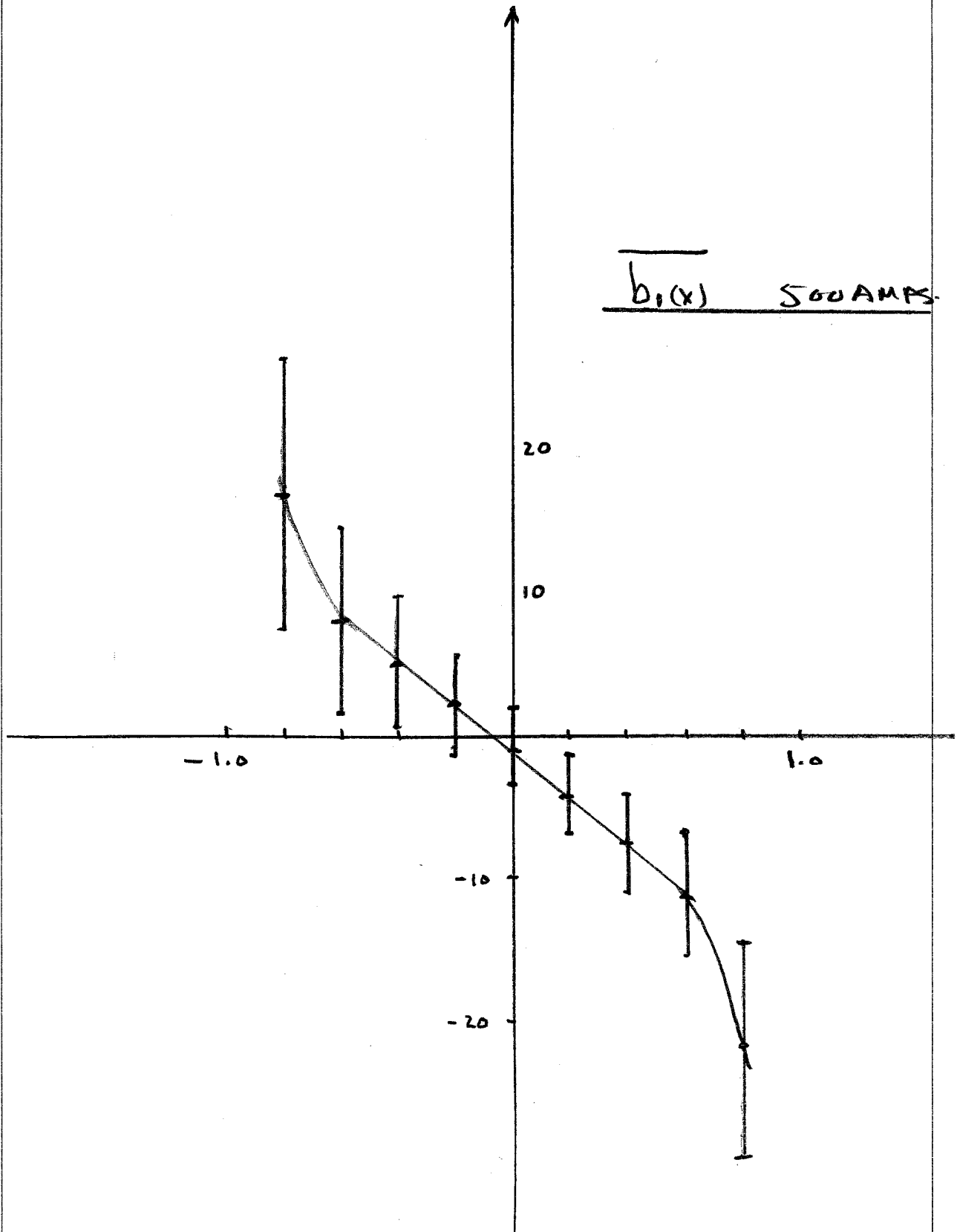


Fig. 1

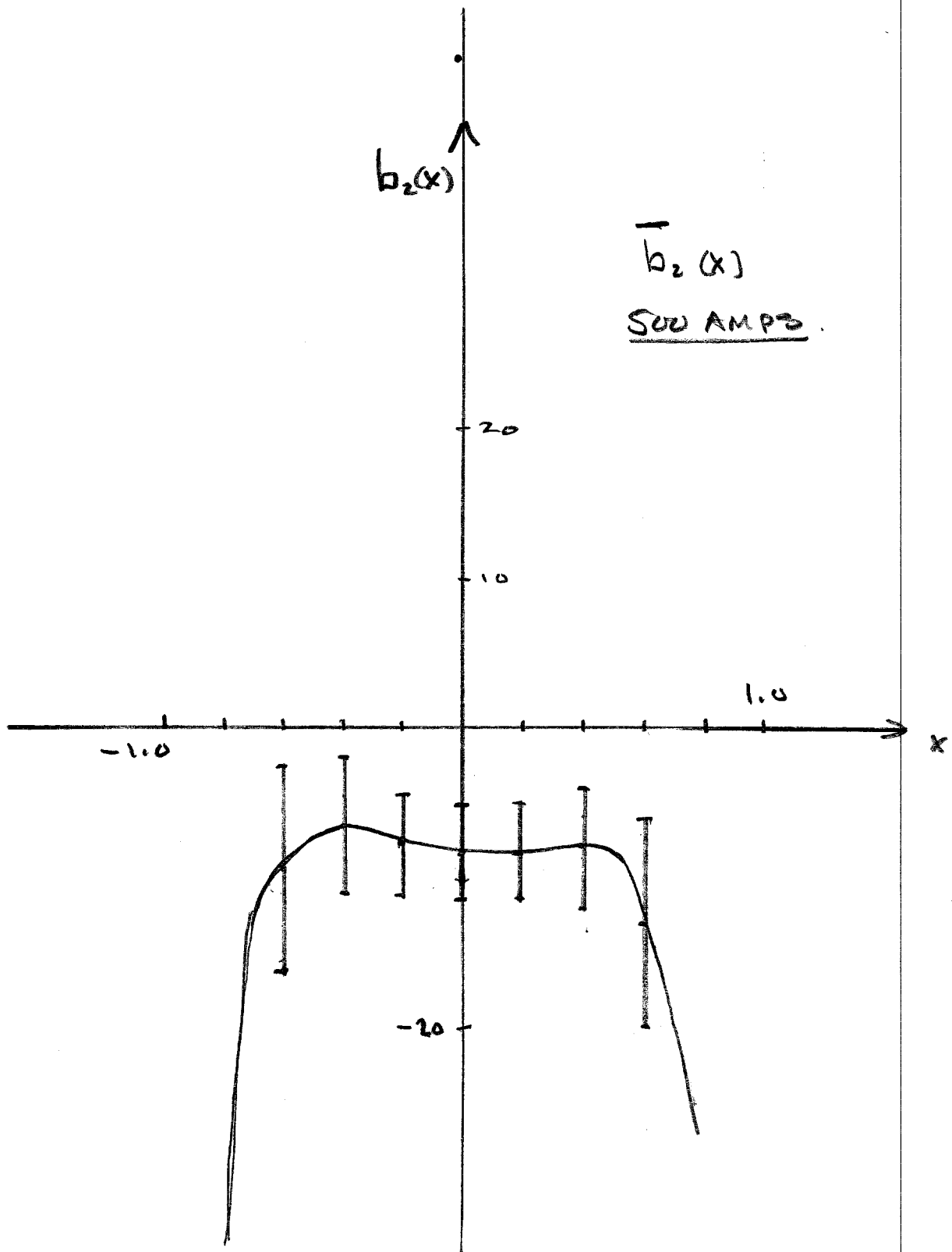


Fig. 2

EFFECT OF  
higher MULTIPOLES  
ON Grad.

$b_1(x)$  500 Amper  
 $b_1(0) \text{ --- } b_4(0) \equiv 0$

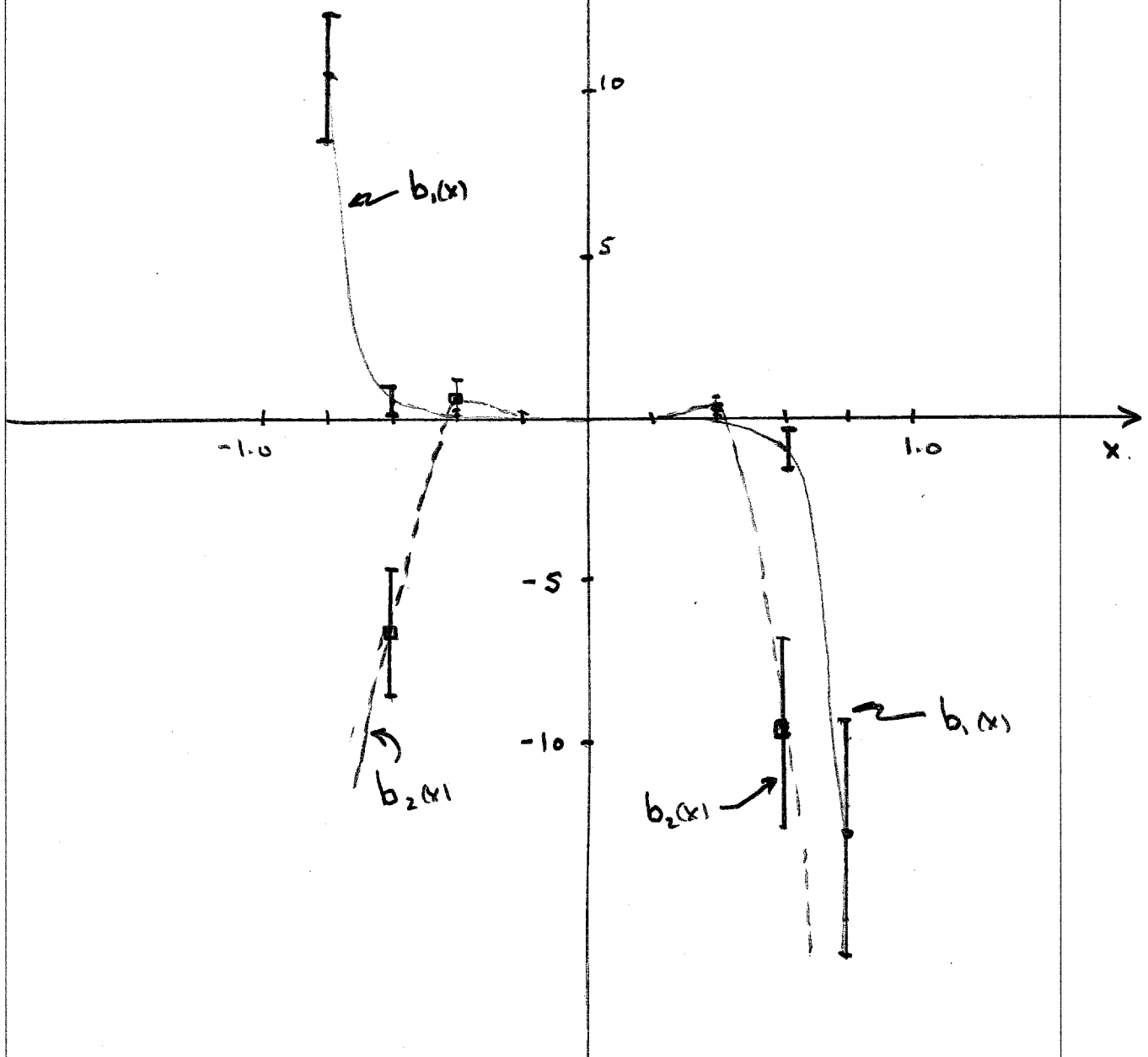


Fig. 3